



Methods of within bale variability study for cotton produced in Africa



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Introduction



- Cotton fibre characterization is important during spinning, weaving, etc.



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Introduction



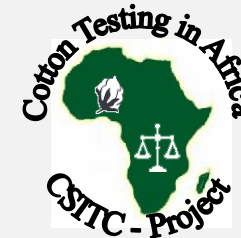
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- Fiber classing and testing have gradually impacted cotton trade worldwide
- Trend to move from manual and visual classing to instrument classing “Standardized Instruments for Testing Cotton” (SITC)



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- Trend to move from manual and visual classing to instrument classing “Standardized Instruments for Testing Cotton” (SITC)
- 50% of the cotton traded in the world classed with SITC measuring Micronaire, length, uniformity, Strength, Reflectance and Yellowness



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- 50% of the cotton traded in the world classed with SITC measuring Micronaire, length, uniformity, Strength, Reflectance and Yellowness
- In Africa, few bales sold with instrumental result



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Introduction



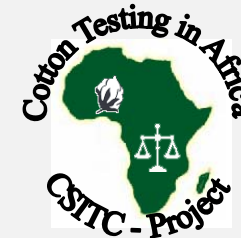
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- Within bale variability depends on
 - the cotton plant
 - cropping system used
 - supply area of the ginning mill
 - seed-cotton management practices
 - ginning equipment and practices



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- Within bale variability depends on
 - the cotton plant
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- Sampling and testing procedures take the within bale variability into account to determine the precision and trueness of fibre characterization



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Introduction



- Larger within bale variability => lower precision of the measurements => higher litigation risk



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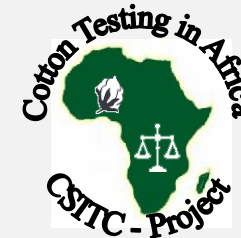
- Larger within bale variability => lower precision of the measurements => higher litigation risk
 - African production conditions differ from the USA
 - cotton farms are smaller, on average 0.6 ha
 - cropping system is largely manual.
- => Each bale includes fiber produced on a larger number of farms under different field conditions than in USA



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- => Each bale includes fiber produced on a larger number of farms under different field conditions than in USA
- => Need to study within bale variability of technological characteristics of cotton fibers in African conditions to set sampling and testing operating conditions



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Objectives of the study



This study focused:

- The supply area of the ginning mills
- The ginning equipment

Goal: to quantify the level of within bale variability as measured by SITC to deduce the most appropriate sampling and testing procedures for African countries

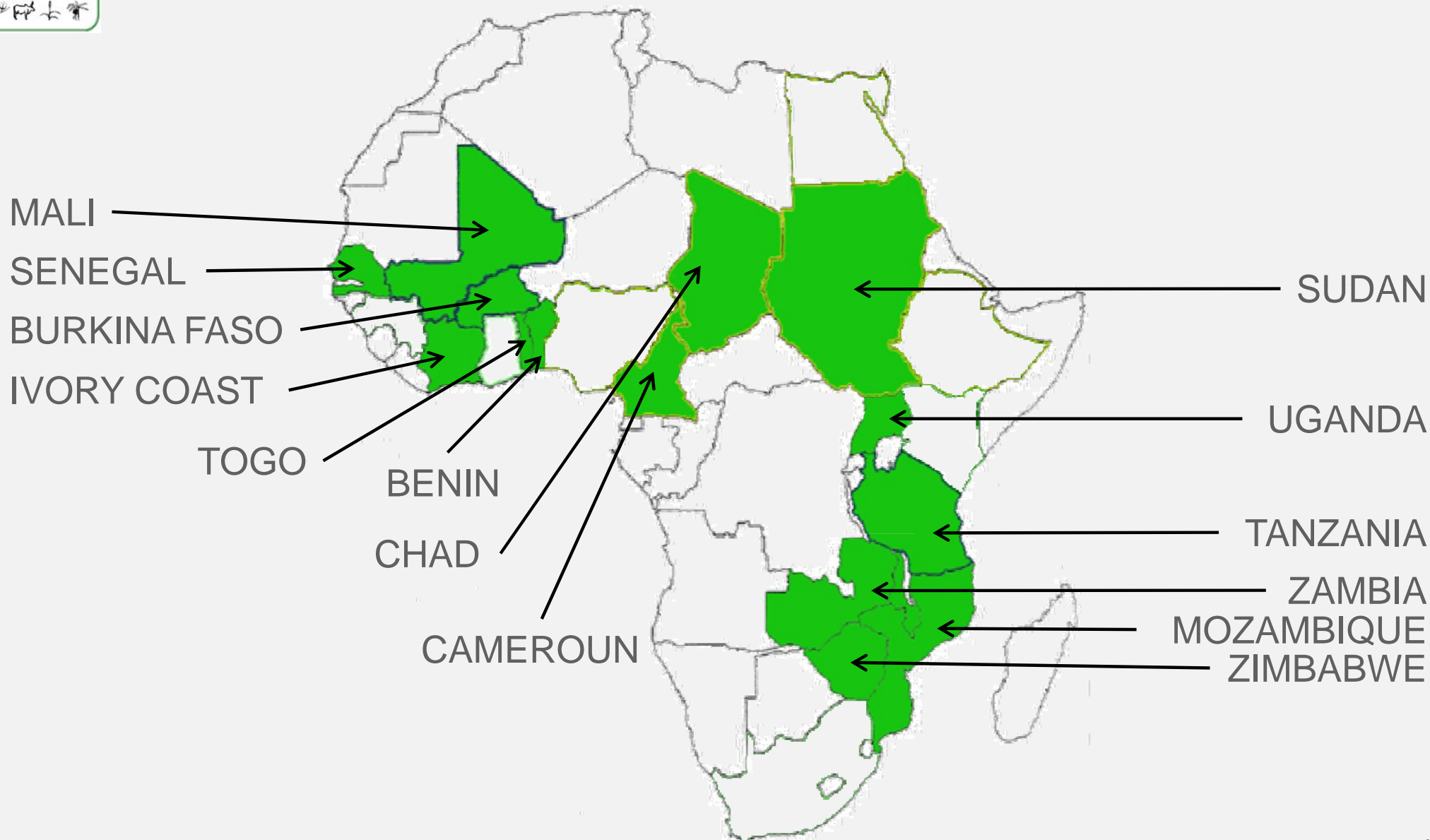
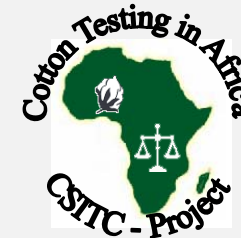
- Bales from 14 African countries



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14 countries involved in the study





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Materials and methods



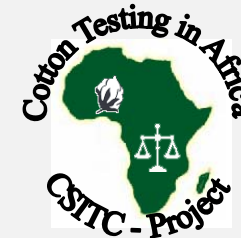
- Two seasons: 2008-2009 season 1 and 2009-2010 season 2
- Sixty three situations were studied for:
 - their seed-cotton supply areas,
 - ginning equipment (roller vs saw) and presence or absence of lint cleaners
 - Season 1, 28 situations were sampled
 - Season 2, 35 situations were sampled
 - Some situations remained the same in both seasons
 - Others were added in the 2nd season to extend the situations



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Sampling cotton fiber for the characterization



- Assumption:
 - Cotton transported in different trucks came from various villages (this may induce different levels of variability)
 - One truck holds around 18 bales of 225 kg of fibres each



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Sampling cotton fiber for the characterization



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 - One truck holds around 18 bales of 225 kg of fibres each
- 1 bale sampled out of every 20 bales in each situation
- 10 bales were sampled in season 1 and 5 bales season 2
- 8 samples were collected per bale



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Sampling cotton fiber for the characterization

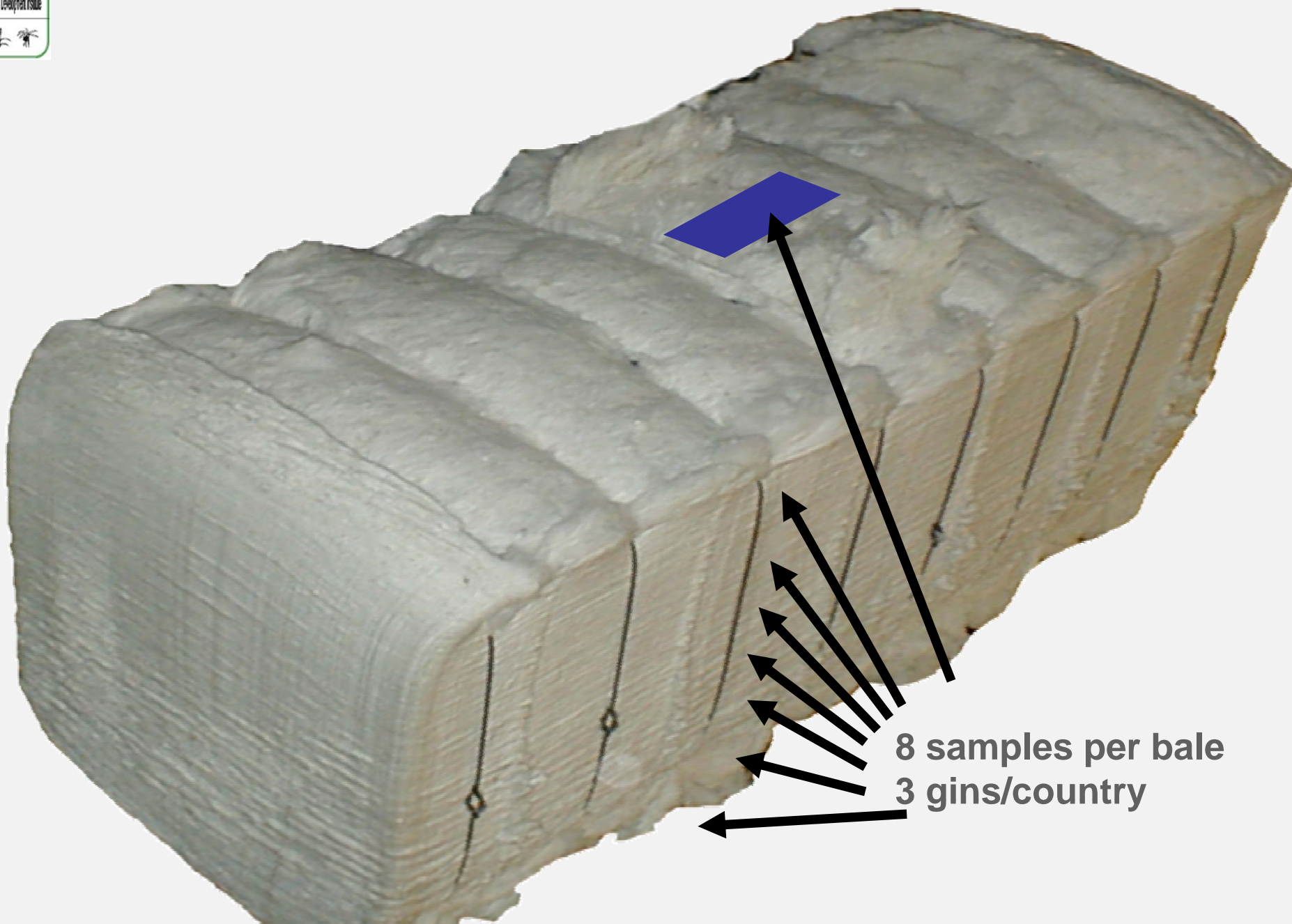


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- =>Season 1: 280 bales and 2239 samples tested
- =>Season 2: 175 bales and 1400 samples



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Samples taken from a bale



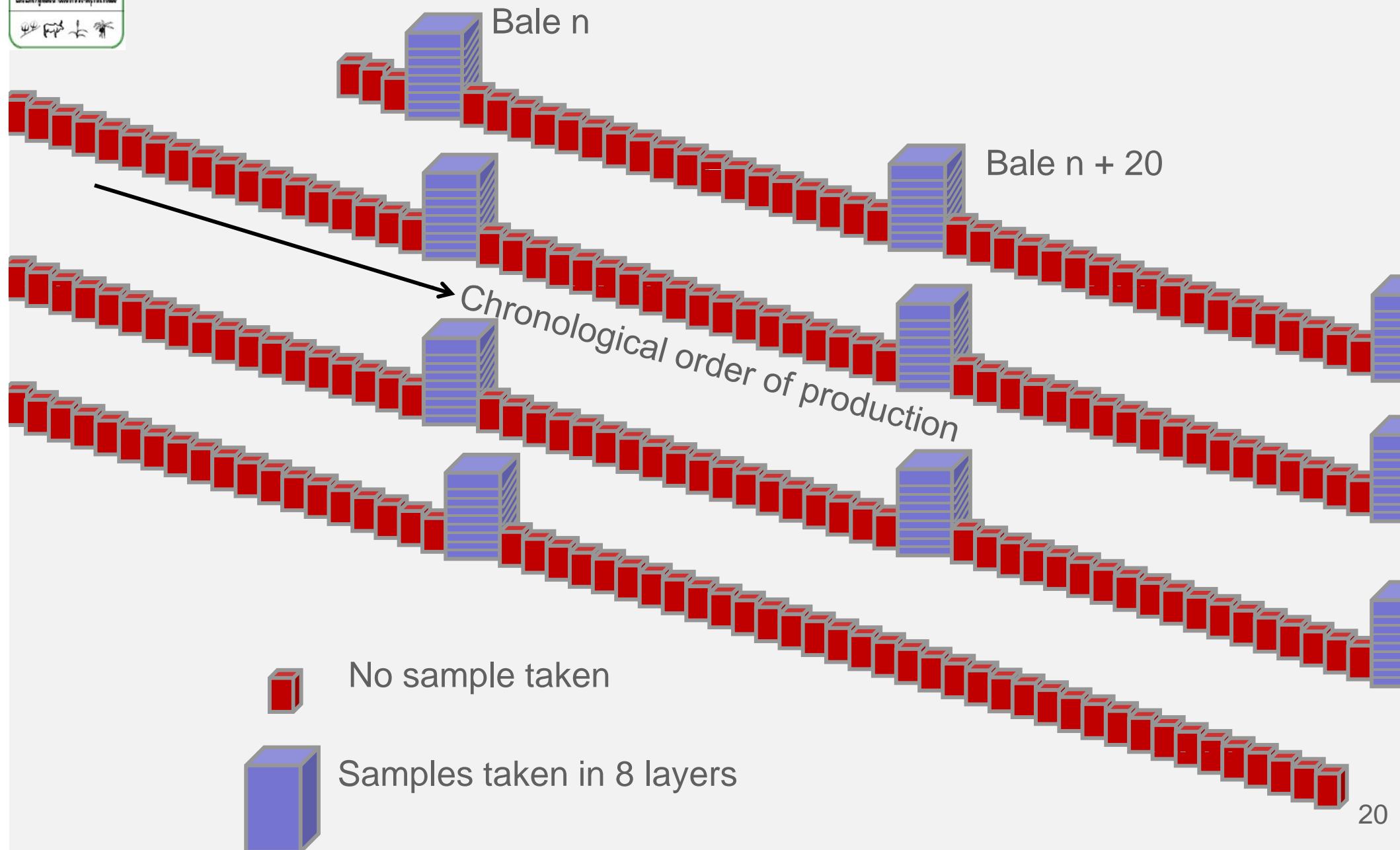
8 samples per bale
3 gins/country



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Samples taken for the study



JPG I need your help to explain in English this part.
Modeste; 29.05.2011



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6 measured characteristics



Micronaire (Mic, Micronaire unit)

Upper Half Mean Length (UHML, mm)

Length Uniformity Index (UI, %)

Strength (Str, g/tex)

Reflectance (Rd, %)

Yellowness (+b, Yellowness unit)

- Uster Technologies model HVI 1000 were used according to CSITC Task Force recommendations.
- Statistical analysis: R software, SAS



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Material and methods



Facts:

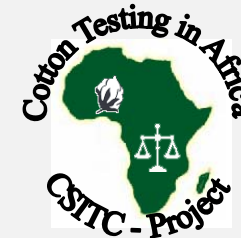
- One bale is the result of stacking successive layers
- One sample from each of the eight layers was evenly distributed in each bale and measured twice



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Model for data analysis



The model for analysing the acquired results was the following:

Measured result $Y =$

μ bale fixed effect

+ A layer random effect , with std deviation σ_A

~~+ B block effect~~

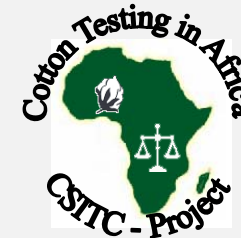
+ E experimental error, with std deviation σ_E



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Model for data analysis



$$Y_{i,j,k} = m_i + A_{ij} + E_{i,j,k}$$

the measured result Y is :

m_i mean of the bale i
 $+ A_{ij}$ random effect of the layer j in the bale i
 $+ E_{i,j,k}$ measurement error of the replicate k
 of the layer j of the bale i

with i in $1 \dots I$ bales
 j in $1 \dots J$ layers in each bale
 k in $1 \dots K$ replicates in each layer.



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Planned mode of exploration of the data



The two retained random effects retained as
variability sources (A and E) as:

σ_A

is the variance of the random layer effect,

σ_E

is the variance of the residual effect

to measure the “overall sampling variance” due to the
operational sampling and testing conditions using a
SITC



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Parameters for choosing sampling and testing conditions



Not exceed a 10% litigation risk on individual bales
Respect commercial usual tolerances

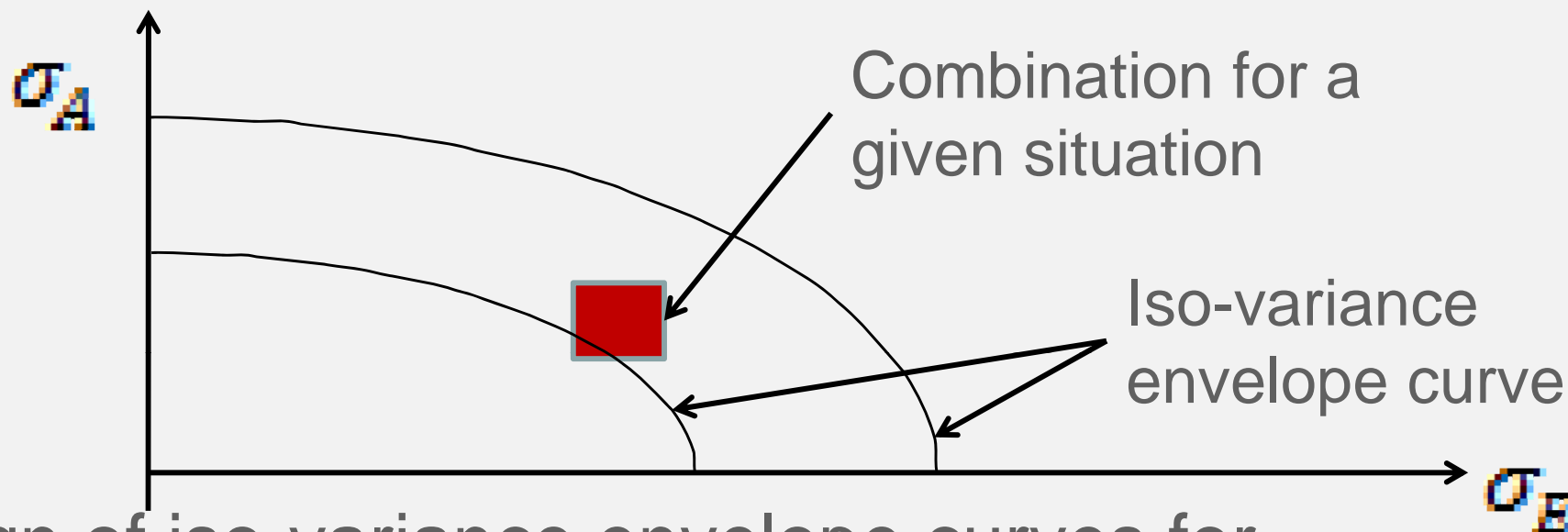
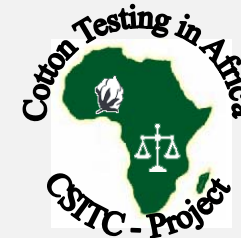
Characteristic	Commercial tolerances
UHML	+/- 0.508 mm
UI	+/- 1 %
Strength	+/- 1.5 g/tex
Micronaire	+/- 0.1 unit
Rd	+/- 1 %
X.b (Yellowness)	+/- 0.5 unit



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Iso-variance curves



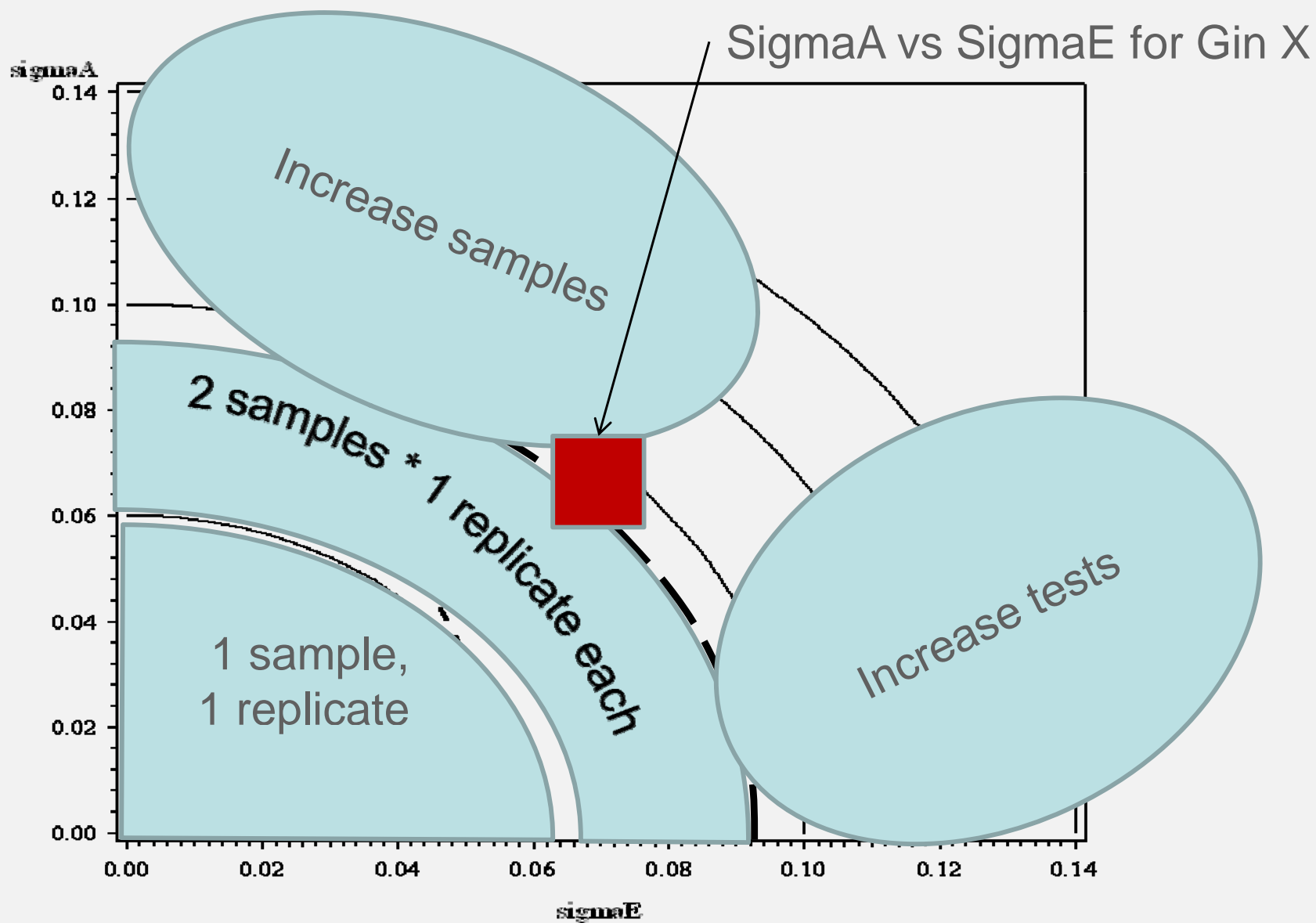
Design of iso-variance envelope curves for determining:

- the number and type (single or combined) of samples per bale
- the number of measurements per bale and the type (composite or cluster) of testing



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Iso-variances curves



stratum

+ + + with lint cleaner Year 2009
o o o without lint cleaner Year 2009

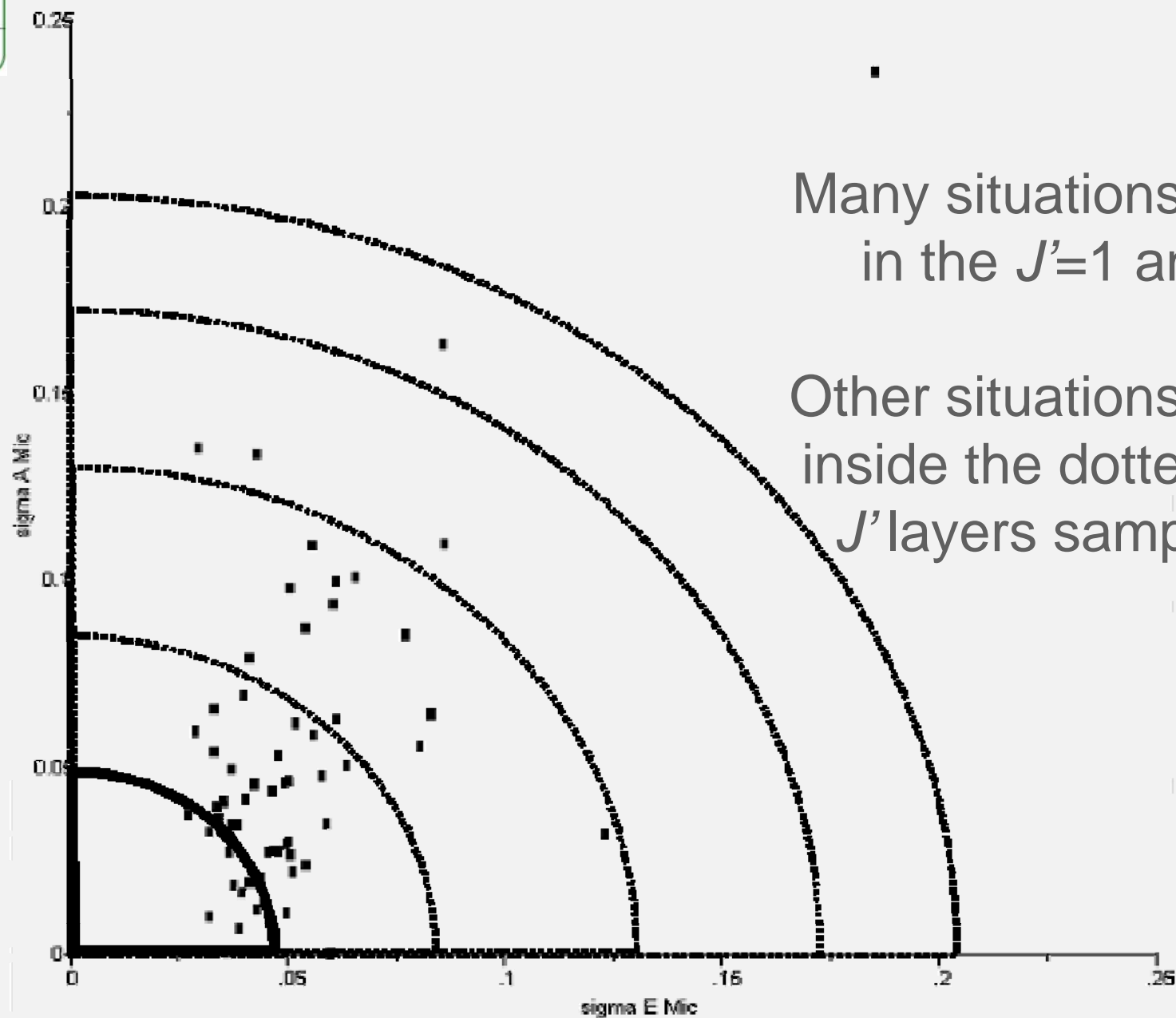
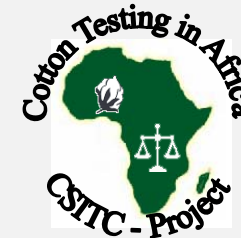
x x x with lint cleaner Year 2010
□ □ □ without lint cleaner Year 2010



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Iso-variance curves for Micronaire



Many situations are included
in the $J'=1$ and $K'=1$ circle

Other situations are included
inside the dotted circles with
 J' layers sampled and $K'=1$
replicate



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Formulas underlying the graphs



From the estimation of standard deviations, we can deduce the variance of the error of estimation of the bale mean :

- ✓ For any sample made of J' layers, each tested K' times (cluster)

$$\sigma_M^2 = \frac{\sigma_A^2}{J'} + \frac{\sigma_E^2}{J'K'}$$

- ✓ For any combined sample from J' layers, and tested N' times (composite)

$$\sigma_M^2 = \frac{\sigma_A^2}{J'} + \frac{\sigma_E^2}{N'}$$

- Upon hypothesis for J', K' and N', study of the improvement of sigma M as a function of sample and test numbers



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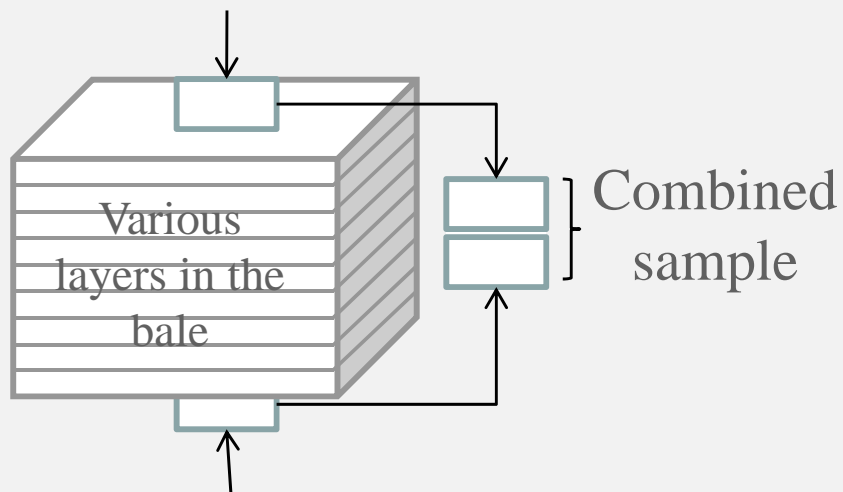


Possibilities in sampling and testing



Sampling in the bale

Sample taken in the layer at the top of the bale



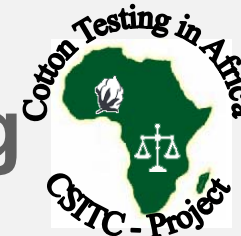
Sample taken in the layer at the bottom of the bale



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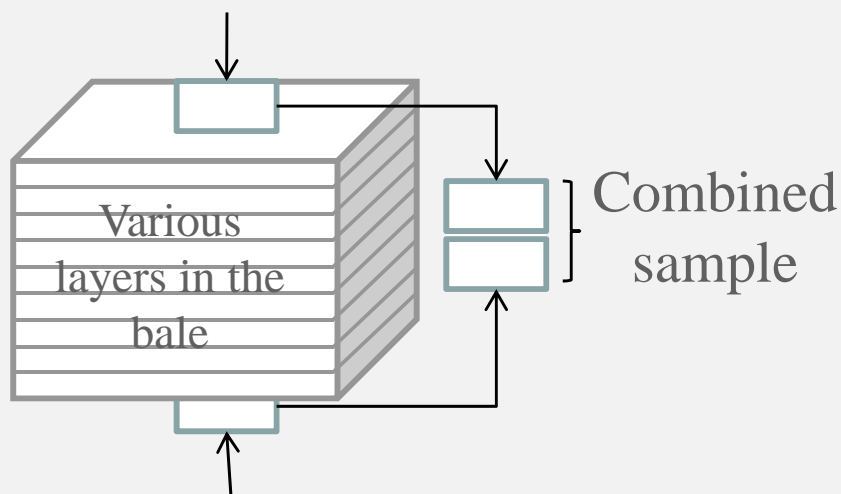


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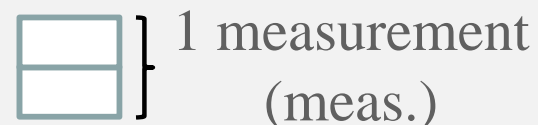


Sample taken in the layer at the bottom of the bale

Sample testing

Sample analysis with one replicate of one measurement per sample

Composite testing



Cluster testing



Sample analysis with one replicate of two measurements per sample

Composite testing



Cluster testing





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Operating methods to be decided by situation - prospects



- Contribution of 'layer' and 'replicate' differed depending on the technological characteristic and the studied situations



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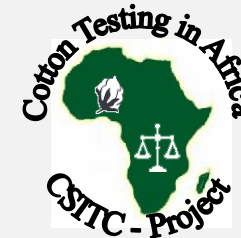
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- For economical optimizations, we may develop specific testing procedures like composite or cluster testing



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- The source of additional variations could be from
 - The effect of the crop season
 - The presence or absence of lint cleaner
 - The ginning equipments



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- Else, adjustments may be necessary in the seed-cotton management practices from field to gin



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Limitations of the study



- Reproducibility conditions - differences from one classing laboratory to the other – not studied



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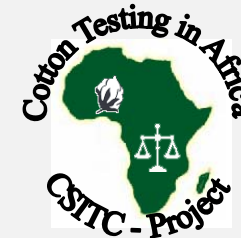
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Positive extension of the study: Periodical monitoring of the within-bale variability for each situation for adjusting / confirming sampling and testing settings while respecting the agreed commercial tolerances and the litigation risk level



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Thank you for your attention



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LUKONGE E., ABOÉ M., GOZÉ E., GOURLOT J.-P.

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